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REVIEW OF PAPERS PRESENTED AT THE SPECIAL SESSION ON MATHEMATICAL MODELLING AT THE SEVENTH TECHNICAL MEETING OF THE IEA COMMITTEE ON AFBC

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MICROMEDIA

Preface

This memorandum addresses the first item of Task 5 of a contract with Supply and Services Canada. The last two items in the task (the major items) are dealt with in the Final Report on the contract. The salient details of the contract are:

DSS Contract Serial No.: OST83-00108

Title: Provide support to the Department of Energy, Mines and Resources in the field of mathematical modelling of fluidized bed combustion at the 7th Combined Technical and Executive Committee Meeting of the IEA Implementing Agreement for Co-operation in the Field of Atmospheric Fluidized Bed Combustion in Industrial or District Heating Boilers, in Pisa and Naples, October 4--7, 1983

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Consignee: Energy, Mines and Resources Canada, Energy Research Laboratories, CANMET, 555 Booth Street, Ottawa, Ontario K1A 0G1

1. Introduction

This memorandum deals with the first item of the fifth task under the subject contract: to provide a brief review of all papers on mathematical modelling presented at the subject IEA meeting. The said papers were given at a special session on mathematical modelling, the program of which (with names of all authors and affiliations) is shown in the Appendix.

2. The reviews

2.1 Xu, et al.: Elutriation rates from fluidized bed combustors and from cold fluidized beds of FBC product particles

A new elutriation model was presented which addressed the question: for particles of a given diameter, what is the division of mass flux leaving the combustor between the overhead (elutriated) stream and the bed overflow stream? A correlation was presented which shows that the split is a function of $D_p/v^{1.163}$ and the fines recycle ratio, where D_p is the particle diameter and v is the fluidizing velocity. Bed depth has virtually no influence.

2.2 Chirone, et al.: Fragmentation and attrition of coal in AFBC

Small batches of coal contained in a wire gauze basket were placed in a 40 mm dia fluidized bed maintained at AFBC temperatures (850 °C). The coal was found to fragment, primarily during devolatilization. The number of fragments produced was studied as a function of time. Attrition was also studied. This work is very significant for mathematical modelling. It is clear that for many coals fragmentation must be taken into account in modelling burning, and it must be characterized experimentally (theory alone cannot predict it).

2.3 Vijil: Experience from the use of an FBC model

A progress report was given on experiences with the development of a fairly complete model of AFBC at Chalmers University. It did not appear that any new departures were being inaugurated (new or very different submodels, etc.), but it was evident that real competence was being developed. The young man, Mr. Vijil, was impressive.

2.4 Arena, et al.: Aspects of modelling FBC

A 370 mm dia pilot-scale combustor was described. Results on carbon attrition and elutriation were reported and some interesting correlations were shown. A South African coal was used. The system is a useful addition to the IEA arsenal. I, for one, would like to have the data to play with, together with our own; I am sure something could be made of it. A good case for data sharing.

2.5 Versteegh: DYSES: Dynamic Simulation Energy Stems

A very interesting approach to analyzing energy systems but not pertinent to mathematical modelling of fluidized combustion in the sense of what the delegates were gathered to discuss.

2.6 D'Amore, et al.: Kinetics of carbon fines from AFBC

Another study of the kinetics of char burning. A careful and critical comparison with literature data and other models would be necessary to determine what's new. Since improvement of combustion efficiency largely hinges on better burnup of fines, the problem is important.

2.7 Andersson: Modelling of slumped zones in FBC

A very good start on this subject which I have not seen treated before. Emphasis was placed on the transition zone between fully fluidized bed and fully slumped bed. Problems with local overheating, clinkering, re-establishing uniform fluidization, etc. were pointed out.

2.8 Donsi, et al.: Fluidized bed desulphurization of the coal from Sulcis District

Results of an experimental study, but no contribution to modelling.

2.9 Evenson & Osterboe: Comments on mathematical modelling activities in Norway

No paper; an oral report to let the members know Norway is interested and developing some capabilities.

Appendix

Program of the Special Session on Mathematical Modelling, Naples, 6 October 1983

9:30 - H.A. Becker, Queen's University, Canada
"Elutriation Rates from Fluidized Bed Combustors and from cold Fluidized Beds of FBC Product Particles"

10:10 - R. Chirone, M. D'Amore, A. Mazza, IRC-CNR and Naples University, Italy
"Fragmentation and attrition of coal in AFBC"

10:50 - Coffee

11:20 - J. Vijil, Chalmers University, Sweden
"Experience from the use of an FBC Mathematical Model"

12:00 - U. Arena, N. Di Muro, M. Miccio, P. Salatino, IRC-CNR and Naples University, Italy
"Aspects of modelling of FBC"

12:40 - Lunch

14:30 - A.M. Versteegh, Netherlands Energy Research Foundation
"DYSES: Dynamic Simulation Energy Stems"

15:10 - S. Andersson, Chalmers University, Sweden
"Modelling of Slumped Zones in FBC"

16:30 - 16:50 - Coffee

16:50 - G. Donsi, A. Cammarota, A. Cianca, Calabria University and Naples University, Italy
"Fluidized bed desulphurization of the coal from Sulcis District"

17:30 - E. Evensen, E. Osterboe, Sintef, Norway
"Comments on the Mathematical Modelling Activities in Norway"